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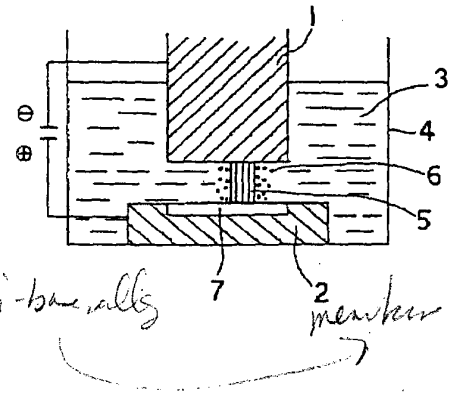
(54) HIGH CORROSION RESISTING SURFACE FINISHING METHOD

(57) Abstract:

PURPOSE: To provide a high corrosion resisting surface finishing method, by which a surface condition adjusting processing and formation of a discharge machining alloy layer can be performed simultaneously, taking an element having good corrosion resistance, an alloy having the element or a conductive ceramics as an electrode using a discharge machining method in order to improve the corrosion resistance and stress corrosion cracking resistance.

CONSTITUTION: The surface of a member 2 to be processed formed by an iron (Fe) base alloy such as a carbon steel, a low-alloy steel, an austenitic stainless steel, or a ferritic stainless steel, a nickel(Ni) base alloy or a cobalt(Co) base alloy is discharge-machined in oil 3 or water 3 using an electrode 1 having at least one high corrosion resisting element to remove the initial surface of the member and form an electric discharge machining alloy layer 7 excellent in corrosion resistance on the surface.



CLAIMS

[Claim(s)]
[Claim 1] Iron (Fe) machine alloys, such as carbon steel, a low alloy steel, an austenitic stainless steel, or a ferritic stainless steel, The front face of the structure which consists of the aforementioned member which receives the structure in a light water reactor or neutron irradiation of the member which consists of a (Nickel nickel) machine alloy or a cobalt (Co) machine alloy the electrode which has a high corrosion resistance element-- using -- the inside of an oil, or underwater -electron discharge method processing --carrying out --the above -- the high corrosion resistance surface treatment method characterized by forming the electron discharge method alloy layer excellent in corrosion resistance in removal on the front face of initial of a member, and this front face
[Claim 2] The high corrosion resistance surface treatment method characterized by being the portion which receives weld zones, such as neutron flux measurement housing, a shroud, a shroud support, an up grid board, and a reactor core supportplate front face, a heat affected zone, or neutron irradiation as the aforementioned structure in a light water reactor furnace in a claim 1.
[Claim 3] In a claim 1 or 2, as an electrode which has a high corrosion resistance element, chromium (Cr), The metal which consists of any one or two components or more among nickel (nickel), iron (Fe), titanium (Ti), niobium (Nb), and a tantalum (Ta), or the alloy containing them is used. as an electron discharge method alloy layer Cr, nickel, Fe, Ti, Nb, and Ta inner -- the high corrosion resistance surface treatment method characterized by forming the alloy layer containing any one or two components or more
[Claim 4] a claim 1 or either of 3 -setting -- as the thickness of an electron discharge method alloy layer -- a processed object --the high corrosion resistance surface treatment method characterized by forming the alloy layer of the range of 5500 micrometers on the surface of a member
[Claim 5] When the aforementioned member is an austenitic stainless steel in a claim 3, It is the range Cr and whose nickel concentration are 0.85 to 1.3 times each concentration of a base material by the weight on the front face. And the high corrosion resistance surface treatment method characterized by containing those compounds and 2% or less of dissolution Ti and Nb, or Ta which fixed the carbon, the oxygen, and the nitrogen atom in a working liquid by Ti, Nb, or Ta, and forming the electron discharge method alloy layer of the range whose thickness is 500 micrometers.
[Claim 6] In the case of the ferritic stainless steel in which the aforementioned member contains 12 18%, and nickel for Cr 2% or less by the weight in a claim 3 The range whose Cr concentration is 0.83 to 1.3 times the concentration of a base material by the weight on the front face, Or in addition to the Cr concentration, nickel concentration is 8% or more of range. Those compounds and 2% or less of dissolution Ti and Nb, or Ta which fixed the carbon, the oxygen, and the nitrogen atom in a working liquid by Ti, Nb, or Ta is contained. The high corrosion resistance surface treatment method which thickness is the range which is 5500 micrometers, and is characterized by forming the electron discharge method alloy layer of either a ferrite phase or gamma phase of nickel content.
[Claim 7] In the case of nickel machine alloy with which the aforementioned member contains Cr 15 to 23%, and contains 2.5 37%, and Mo for Fe 16% or less by the weight in a claim 3 It is the range Cr and whose nickel concentration are 0.83 to 1.5 times each concentration of a basmaterial by the weight on the front face. And those compounds and 2% or less of dissolution Ti and Nb, or Ta which fixed the carbon, the oxygen, and the nitrogen atom in a working liquid by Ti, Nb, or Ta is contained.

The high corrosion resistance surface treatment method which thickness is the range which is 500 micrometers, and is characterized by forming the electron discharge method alloy layer of either gamma single phase or the mixed phase of gamma and gamma'.

[Claim 8] When the aforementioned member is carbon steel or a low alloy steel, in a claim 3, Cr concentration by the weight on the front face 9% 12%, Or Cr concentration is [17% 19% and nickel concentration] 13% or less of ranges. And the high corrosion resistance surface treatment method characterized by containing those compounds and 2% or less of dissolution Ti and Nb, or Ta which fixed the carbon, the oxygen, and the nitrogen atom in a working liquid by Ti, Nb, or Ta, and forming the electron discharge method alloy layer of the range whose thickness is 500 micrometers.

[Claim 9] Iron (Fe) machine alloys, such as carbon steel, a low alloy steel, an austenitic stainless steel, or a ferritic stainless steel, The front face of the structure which consists of the aforementioned member which receives the structure in a light water reactor or neutron irradiation of the member which consists of a (Nickel nickel) machine alloy or a cobalt (Co) machine alloy Electron discharge method processing is carried out in the inside of an oil, or underwater using a conductive ceramic electrode. at the same time it removes an initial front face- a front face --the above -- the high corrosion resistance surface treatment method characterized by forming the electron discharge method alloy layer which consists of the amorphous layer which consists of the constituent element and electrode component element of a member, a fine crystalline layer, or a layer which the ceramic particle distributed

[Claim 10] The high corrosion resistance surface treatment method characterized by being the portion which receives weld zones, such as neutron flux measurement housing whose aforementioned member is the structure in a light water reactor furnace, a shroud, a shroud support, an up grid board, and a reactor core support plate front face, a heat affected zone, or neutron irradiation in a claim 9.

[Claim 11] The high corrosion resistance surface treatment method characterized by using the sialon (Sialon) or silicon carbide (SiC) of a titanium boride (TiB2) and titaniumnitride (TiN) content as a conductive ceramic electrode in a claim 9 or 10.

[Claim 12] energy, such as a laser beam after forming an electron discharge method alloy layer by electron discharge method processing in a claim 1 or either of 11, an electron beam, or a TIG arc, irradiating -- an electron discharge method alloy layer and a processed object- the high corrosion resistance surface treatment method characterized by carrying out rapid solidification and forming a remelting surface alloy layer after making some processed metals which are members remelt

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[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the high corrosion resistance surface treatment method which starts the surface-treatment processing technology of the sake on the corrosion resistance which makes a high anticorrosion-alloy layer form in the front face of the structure which receives the structure in a light water reactor, or neutron irradiation, and a stress-corrosion-cracking-proof disposition, especially contributes to the reinforcement of a light water reactor plant.
[0002]
[Description of the Prior Art] Conventionally, the vacuum evaporation-o which a paint, plating as the electrochemical technique, etc. are utilized in ancient times as corrosion prevention cure technology of a material-list side in which environment receives a corrosion injury, and is performed in vacuum atmosphere in recent years, a chemical vacuum deposition, a physical vapor deposition, and an ion implantation are being applied. It is in these methods only mainly forming a corrosion-resistant metallic film in a material-list side, and it cannot be said that the meaning of forming the film which improves adhesion with material and corrosion resistance is enough. On the other hand, the method of carrying out surface treatment of the material-list side by the electron discharge method is proposed. For example, there are (I) JP,62-4916,A, (II) JP,2-83119,A, etc. Moreover, a material-list side is fused and the technology of the TIG arc process which made the heat source the TIG arc or laser beam which uses only composition of material, adjustment, or the surface section of material as high anti-corrosion combination gold, or laser is being applied.
[0003]
[Problem(s) to be Solved by the Invention] There are some technical problems in high anti-corrosion-ization of the lowered material-list side of the material-list side which is under a corrosive environment or has a possibility that it may be exposed to this environment, and corrosion resistance. The problem of the existence of the optimal method for giving the 1st at the problem of washing-izing on the front face of processing, and giving high corrosion resistance to the 2nd on a front face is mentioned. Washing-ization on the front face of processing is performed using the technique in which the purpose differs from anticorrosion-ization, for example, machining, and the chemical and electrochemical technique. However, in the surface treatment of the structure in a furnace of the object part covered by corrosion resistance lowered front face or lowered corrosion product, for example, the light water reactor system, since it is the severe conditions of the work under a radiation environment, the technique of the ability to do simultaneously surface-washing-izing and surface-treatment technology as pretreatment of high anticorrosion-ized surface treatment is desired. Moreover, also in the usual surface treatment, it is unrelated in the shape of surface type, and the technology in which surface-state adjustment processing and high anticorrosion-ized surface-treatment processing can make simultaneous the front face which is not decontaminated has a large role over an industry top. There is the surface treatment method by the electron discharge method as technology on which this technical problem is satisfied. It will progress by the heat input to an electron discharge method being small, and surface alloying process carrying out the melting evaporation of an electrode and the surface-treatment-ed work by minute electric discharge between an electrode and a surface-treatment-ed work, and carrying out melting of the congelation to a surface-treatment-ed work front face with evaporation of a working liquid. Although a front face is

alloyed by many duplication electric discharge, since the influence on a no-processed region is small, one an electric discharge surface area and heat input are excellent also in the small deer as the surface treatment method of material.
[0004] as the high anti-corrosion-ized surface-treatment method by this electron discharge method, although (I) of the column of the conventional technology and (II) are proposed, by the electron discharge method, the method indicated by (I) must say that an amorphous layer or fine crystalline layers, such as silicon (Si), will be formed in a surface-treatment-ed work front face, and must arrange layers, such as Si, in a conductive copper front face as an electrode there is a problem Moreover, by making Si powder contributed to an oxidation-resistant surface treatment mix into electron discharge method liquid, and carrying out an electron discharge method, the method indicated by (II) says that the amorphous layer or fine crystalline layer of silicon (Si) will be formed in a surface-treatment-ed work front face, and has the problem which must perform special processing to electron discharge method liquid. Moreover, when it was going to apply the technology of a TIG arc process or laser independently, such surface scorification had the demerit which changes the physical properties of material around a surface treatment part, when it heated by high heat input.
[0005] therefore, the alloy or the conductive ceramics which electric spark forming is used for the purpose of this invention a sake [on the corrosion resistance of the front face of the structure which receives the structure in a light water reactor, or neutron irradiation, and a stress-corrosion-cracking-proof disposition], and contains corrosion resistance good elements or these elements an electrode -- carrying out --reforming --a member --it is in offering the high corrosion resistance surface treatment method which forms the electron discharge method alloy layer which has the surface-state adjustment processing and high corrosion resistance as surface pretreatment
[0006] Moreover, another purpose of this invention is to offer the high corrosion resistance surface treatment method which can form the remelting surface alloy layer which applies the technology of a TIG arc process or laser further, and is excellent in corrosion resistance in the electron discharge method alloy layer which formed the front face of the structure which receives the structure in a light water reactor, or neutron irradiation using electric spark forming.
[0007]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, the following methods are used as a surface-treatment approach by this invention. namely, the electrode which has at least one high corrosion-resistance element for the front face of the structure which receives the structure in a light water reactor or the neutron irradiation which consists of iron (Fe) machine alloys, such as carbon steel, a low alloy steel, an austenitic stainless steel, or a ferritic stainless steel, a (Nickel nickel) machine alloy, or a cobalt (Co) machine alloy- using --the inside of an oil, or underwater -- electron discharge method processing -- carrying out- the above --it be characterized by to form the electron discharge method alloy layer excellent in corrosion resistance in
[0008] Moreover, iron (Fe) machine alloys, such as carbon steel, a low alloy steel, an austenitic stainless steel, or a ferritic stainless steel, The front face of the structure which receives the structure in a light water reactor or neutron irradiation which consists of a (Nickel nickel) machine alloy or a cobalt (Co) machine alloy Electron discharge method processing is carried out in the inside of an oil, or underwater using a conductive ceramic electrode. at the same time it removes an initial front faee - a front face -- a processed object- it is characterized by forming the electron discharge method alloy layer which consists of the amorphous layer which consists of the constituent element and electrode component element of a member, a fine crystalline layer, or a layer which the ceramic particle distributed
[0009] energy, such as a laser beam after forming an electron discharge method alloy layer by electron discharge method processing in these surface-treatments approach, an electron beam, or a TIG arc,-- irradiating --an electron discharge method alloy layer and a processed object -after making some structures which receive the structure in a light water reactor or neutron irradiation which is a member remelt, it is characterized by carrying out rapid solidification and forming a remelting surface alloy layer
[0010]
[Function] In this invention, electron discharge method processing is carried out between an

electrode and the processed metal which is material, and an electron discharge method alloy layer is formed in a processed surface of metal. Surface alloying process will carry out the melting evaporation of an electrode and the processed surface of metal by minute electric discharge between an electrode and a processed metal, and when the congelation fuses to a processed surface of metal and is alloyed with evaporation of a working liquid, it will progress. Although a front face is alloyed by many duplication electric discharge, since the influence on a non-processed region is small, the heat input to one an electric discharge surface area and an electron discharge method is excellent also in the small deer as the surface treatment method of material.

[0011] If it is in this invention, the combination of an electrode and a processed metal is important. If what has a high corrosion resistance element as an electrode is used, the electron discharge method alloy layer of high corrosion resistance will be formed in a processed surface of metal. Moreover, if conductive ceramics are used as an electrode, the electron discharge method alloy layer which consists of the amorphous layer which becomes a processed surface of metal from a metaled constituent element and a metaled electrode component element, a fine crystalline layer, or a layer which the ceramic particle distributed will be formed. The thickness of an electron discharge method alloy layer has desirable 5-20 micrometers.

[0012] Thus, since rapid solidification is carried out and a remelting surface alloy layer is formed after irradiating energy, such as a laser beam, an electron beam, or a TIG arc, to the formed electron discharge method alloy layer and making some of electron discharge method alloy layers and processed metals remelt, corrosion resistance and stress-corrosion-cracking-proof nature can be raised, without changing the physical properties of material a lot around a surface treatment part.

[0013] this invention The weld zone containing the heat affected zone and the melting solidification section of the welded structure in a light water reactor which consist of the member and these alloy member of iron (Fe) machine alloys, such as carbon steel, a low alloy steel, a ferritic stainless steel, or an austenitic stainless steel, (Nickel nickel) machine alloy, or a cobalt (Co) machine alloy, Or the chromium which is a high corrosion resistance element about the front face of the structure in a furnace which has the portion which receives neutron irradiation (Cr), Consist of any one or two components or more among nickel (nickel), titanium (Ti), niobium (Nb), and a tantalum (Ta). Or the corrosion resistance of this portion and stress-corrosion-cracking-proof nature are raised by making the electron discharge method alloy layer which has high corrosion resistance form at the same time it carries out electron discharge method processing in the working liquid of an oil or water and removes an initial front face, using the alloy containing them as an electrode.

[0014] The principle of the surface-treatment formation method of the member by this invention is explained using drawing 1 . Drawing 1 is the ** type view of electron discharge method processing of the high corrosion resistance surface treatment method by this invention. In the processing tub 4 containing the working liquid 3 which is an oil or water, the processed metal 2 and electrode 1 which are the material for processed are contained. The processed metal 2 is a member which consists of Fe basis alloys, such as carbon steel, a low alloy steel, an austenitic stainless steel, or a ferritic stainless steel, a nickel machine alloy, or a Co basis alloy, and is the portion welding heat influenced [the weld zone or]. An electrode 1 consists of any one or two components or more among Cr, nickel, Fe, Ti, Nb, and Ta, or uses the alloy containing them. By passing a pulse current to this electrode 1, and taking electric discharge 5 for it, melting and the evaporation of a part of electrode 1 and the surface section of the processed metal 2 are done, and an initial front face is removed, and the melting alloy grain 6 carries out cooling solidification on the front face of the processed metal 2 with evaporation of a working liquid 3, and the electron discharge method alloy layer 7 is formed. Including the alloy element of high corrosion resistance [alloy layer / electron discharge method / 7], since it is a uniform layer by rapid solidification, the oxide film is very stable and improvement in corrosion resistance or stress-corrosion-cracking-proof nature is attained.

[0015] In the case of the thing and ferritic stainless steel which contain Cr 8 to 30% by the weight as a processed metallic material to which this invention is applied in the case of general carbon steel, a low alloy steel, and an austenitic stainless steel, in the case of less than 2% **** thing or nickel machine alloy, there are some which contain Cr for 12-18% and nickel by the weight, and contain 2.5 - 37% and Mo for Fe 0 to 16% 15 to 23% about Cr by the weight in 12-20%, and nickel.

[0016] The alloy which considers the stainless steel of high corrosion resistance, nickel which is

nickel machine alloy content, Cr element, or them as composition as an electrode material is desirable to electron discharge method alloylayer 7 formation of high corrosion resistance. If the alloy which contains nickel, Cr element, or them especially is used, to a raise on carbon steel and the front face of a low alloy steel in anti-corrosion, it is suitable also because of [for surface nickel and high-concentration-izing of Cr] a raise in nickel content anti-corrosion [of a ferritic stainless steel].
[0017] The meaning of using Ti, Nb, or Ta as a component of an electrode material or an alloy electrode is in preventing that carbon and nitrogen in a working liquid, i.e., an oil, and underwater oxygen carry out rapid solidification as a simple substance, mix to an electron discharge method alloy layer, and cause quality-of-the-material degradation, and making it fixingize to an electron discharge method alloy layer as a compound of Ti, Nb, or Ta. For sufficient fixinging of carbon, oxygen, or nitrogen, it is desirable that the concentration of Ti, Nb, or Ta forms the electron discharge method alloy layer 7 of the content to about 2% in the front face to all the members of Fe basis alloys, such as carbon steel, a low alloy steel, and stainless steel, nickel machine alloy, or Co basis alloy.
[0018] The reforming front face of the processed metal which improved the corrosion resistance acquired by this invention and stress-corrosion-cracking-proof nature is the electron discharge method alloy layer 7 formed of electron discharge method processing, and is an alloy organization containing composition and working-liquid composition of any one or two alloys or more of Cr, nickel, Ti, Nb, and Ta which are used as an electrode. Although it is dependent on electron discharge method current, in order for the thickness of this electron discharge method alloy layer 7 to give a flatter field state and not to have too much thermal effect on the base material (processed metal 2) front face of the processing section circumference, it is desirable that it is in the range of 500 micrometers to all the carbon steel, low-alloy-steel, stainless steel, and nickel machine alloys.
[0019] After electron discharge method processing, in order for Cr in the electron discharge method alloy layer 7 obtained by rapid solidification and nickel concentration to maintain the concentration grade of a base material (processed metal 2), and connection to base material composition a sake [on the corrosion resistance accompanying a surface treatment, and a stress-corrosion-cracking-proof disposition], as for too much concentration elevation, avoiding is desirable. Since a toughness fall is produced especially in the concentration of Cr for the sigma-phase formation by high-concentration-izing, an upper limit is required in order to prevent this. Therefore, about 8% from which the amount of nickel serves as [Cr] SUS304 component 0.83 to 1.5 times as desirable as Cr concentration of a base material about 1.0 to 1.3 times and nickel addition to 1.1 to 1.3 times and a ferritic stainless steel to an austenitic stainless steel 0.85 to 1.3 times as preferably as each concentration in a base material, or more than it of Cr in the electron discharge method alloy layer 7 and the amount of nickel is desirable. It is good that the amount of Cr(s) becomes 1.1 to 1.5 times to nickel machine alloy 0.83 to 1.5 times as preferably as Cr concentration of a base material. In carbon steel or a low alloy steel, in order to make the electron discharge method alloy layer 7 which is a surface layer SUS304 or 316 austenitic-stainless-steel composition, that 13% or less or whose Cr concentration 17 - 19% and nickel concentration is 9 - 12% by the weight in the electron discharge method alloy layer 7 for Cr concentration is desirable.
[0020] The very good amorphous layer of corrosion resistance [alloy layer / electron discharge method / 7 / which furthermore consists of elements, such as Cr, nickel, Fe, Ti, Nb, and Ta,] is also obtained. Moreover, when it is a fine crystalline, it becomes a metastable and uniform layer by rapid solidification, and corrosion resistance is good.
[0021] Although it consisted of any one or two components or more in Cr, nickel, Fe, Ti, Nb, and Ta or the example using the alloy containing them as an electrode has explained until now, the ceramic electrode which has conductivity, such as a titanium boride (TiB2), titanium nitride (TiN) content sialon (Sialon), or a silicon carbide (SiC), can also be used as an electrode material. An electron discharge method is carried out in the working liquid of an oil or water, and while removing an initial front face, the amorphous layer which consists of a metaled component element and a metaled electrode component element, a fine crystal layer, or the layer which distributed the ceramic particle can be made to form in the front face of the processed metal which is processed material using this conductive ceramic electrode. It is the processing in which the electron discharge method alloy layer 7 which is made to discharge in a working liquid, is made to carry out melting of a part of electrode

near the processed surface of metal in the surface treatment by the electron discharge method, and becomes a processed surface of metal from the component element and an electrode component element, and by which rapid solidification was carried out is made to form. Steel, stainless steel, an Inconel, etc. are used as a processed metal, and the electron discharge method alloy layer 7 which consists of a processed metal component which consists of Fe, Cr, nickel, C, etc., and electrode components, such as B, Si, C, etc. which suppress atomic diffusion, and by which rapid solidification was carried out is formed in a front face at the same time it removes an initial front face, when it discharges in the working liquid which consists of an oil or water using the abovementioned thing as an electrode material. An amorphous layer is formed when a cooling rate increases by control of the component range and a spark discharge energy. When the abovementioned alloy layer is the amorphous organization where an oxide film is stable, the corrosion resistance of the surface treatment section improves remarkably. Moreover, even when the abovementioned alloy layer does not turn amorphously, the corrosion resistance of the surface treatment section which the oxide film formed in the bottom of a corrosive environment becomes from the quenching organization of a stable fine crystalline improves greatly compared with nonprocessing material. Moreover, when an alloy layer also doubles and has sufficient mechanical strength, stresscorrosion-cracking-proof nature also improves. Furthermore, when the abovementioned alloy layer is the amorphous organization which has sufficient degree of hardness, or even when not turning amorphously, the abrasion resistance of the surface treatment section which serves as a quenching organization of the fine crystalline which has sufficient degree of hardness, or a quenching organization which a ceramic particle distributes improves remarkably compared with nonprocessing material.

[0022] Thus, when the adhesion of the electron discharge method alloy layer 7 and the processed metal 2 which were formed by electron discharge method processing is inadequate, Or when defects, such as a crack, are shown in the front face of the electron discharge method alloy layer 7, after forming the electron discharge method alloy layer 7, irradiate the energy 9, such as a laser beam, an electron beam, or a TIG arc, remelt some of electron discharge method alloy layers 7 and processed metals 2, and a defect is disappeared. And the processed metal 2 and the stuck remelting surface alloy layer 10 can be formed. Since this layer is a rapid solidification layer by self-cooling, it excels in adhesion and an above-mentioned amorphous layer or an abovementioned uniform fine crystalline layer can be formed again. Therefore, the corrosion resistance of the portion in which this remelting surface alloy layer 10 was formed, and stresscorrosion-cracking-proof nature can be raised.

[0023] this invention into the portion into which corrosion resistance and stresscorrosion-cracking-proof nature deteriorated in neutron flux measurement housing which is the structure in a light water reactor furnace, a shroud, the shroud support, the up grid board, the reactor core supplate front face, and the weld zone By carrying out an electron discharge method in the working liquid of an oil or water, and making the electron discharge method alloy layer 7 which has high corrosion resistance at the same time it removes the initial front face to which the oxide film has adhered, or the remelting surface alloy layer 10 form The corrosion resistance of this portion and stresscorrosion-cracking-proof nature are raised, and reinforcement of the light water reactor plant is carried out. Moreover, since the operation temperature of a boiling-water-reactor plant is about 288 degrees C, organization change to the extent that corrosion resistance is affected in the case of crystallization of the above mentioned amorphous layer or aging change of a fine-crystalline quenching organization etc. and abrasion resistance is affected does not produce, but the property of the structure in a light-water-reactor furnace improves greatly, and a big effect is in prevention of degradation of the many years past-corrosion resistance of a light-water-reactor plant, and correspondence force corrosion-cracking nature.

[0024]

[Example]

(Example 1) Drawing 1 is the cross section of the equipment which forms the electron discharge method alloying layer 7 which has the high corrosion resistance by electron discharge method processing. Electron discharge method processing is carried out between an electrode 1 and the processed metal 2 into the working liquid 3 which consists of an oil. In this example, as a result of carrying out an electron discharge method, using Cr electrode as an electrode 1, using SUS304

stainless steel as a processed metal 2, the electron discharge method alloy layer 7 with uniform about 5-micrometer thickness is formed, and very good corrosion resistance is acquired. Moreover, similarly, when an electron discharge method is carried out using Ti electrode as an electrode 1 using SUS304 stainless steel as a processed metal 2, about the electron discharge method alloy layer 7 formed, thickness is about 5 micrometers and very good corrosion resistance as well as the case where it is Cr electrode is acquired. These electron discharge method conditions make a parameter electrode polarity, current, a pulse period, the quiescent time, and floor to floor time, and as shown in Table 1, they set them up.

[0025]

[Table 1]

電　極	Ｃｒ	Ｔｉ
電極特性	—	—
電　流	10A	10A
パルス幅	2μs	2μs
休止幅	16μs	16μs
加工時間	10～30min	

[0026] (Example 2) Drawing 2 is a ** type view in the case of irradiating the energy 9, such as a laser beam, an electron beam, or a TIG arc, in the surface section containing the electron discharge method alloy layer 7 formed by electron discharge method processing, remelting some of electron discharge method layers 7 and processed metals 2, and making the remelting surface alloy layer 10 form by the rapid solidification by selfcooling. When the adhesion of the electron discharge method alloy layer 7 and the processed metal 2 is inadequate, or when defects, such as a crack, are shown in the front face of the electron discharge method alloy layer 7, the remelting surface alloy layer 10 which irradiated the energy 9, such as a laser beam, an electron beam, or a TIG arc, from the processing torch 8, remelted some of electron discharge method alloy layers 7 and processed metals 2, and disappeared the defect, and was stuck with the processed metal 2 can be formed. Since this layer is a rapid solidification layer by selfcooling, it has the same good corrosion resistance as the electron discharge method alloy layer 7, and stress-corrosion-cracking-proof nature.

[0027] (Example 3) Drawing 3 is a ** type view in the case of carrying out electron discharge method processing to the system as an application of this invention for the purpose of improvement in the corrosion resistance in the inside of a tubular structure object like neutron measurement housing of a light water reactor, or stress-corrosion-cracking-proof nature. When the processed metal 2 which is a tubular structure object is welded with other structures 14, such as a pressurized container, and the pipe inside which touches corrosive environments, such as furnace water, by the thermal effect of a weld zone 15 carries out sensitization, the stress-corrosion-cracking property of the processed metal 2 deteriorates. The electron discharge method alloy layer 7 can be formed by electron discharge method processing as shown in the example 1 to such a part front face. the rotation drive system held at the nose of cam of the vertical-drive system rod 13 the electron discharge method cell 11 attached in the member 12 is moved by the drive to a perpendicular and a hand of cut, and the electron discharge method alloy layer 7 is formed in this part front face that deteriorated -- as -- an electron discharge method-- winding -- ****** The electrode 1 shown in the example 1 is arranged by the electron discharge method cell 11, and it carries out an electron discharge method, using furnace water as a working liquid 3, maintaining appropriately the crevice between the processed metals 2 which are this electrode 1 and a pipe inside. It reforms to the good electron discharge method alloy layer 7 of the corrosion resistance which showed the front face of the field where the pipe inside deteriorated in the example 1 by this, or stress-corrosion-cracking-proof nature.

[0028] (Example 4) Drawing 4 is a ** type view in the case of carrying out electron discharge method processing to the system as an application of this invention for the purpose of improvement in the corrosion resistance of a nontubular structure object like the shroud in a light water reactor, or stress-corrosion-cracking-proof nature. When the structure which touches corrosive environments,

such as furnace water, by the thermal effect of the weld zone 15 of the processed metal 2 which is a non-tubular structure object carries out sensitization, the stress-corrosion-cracking property of the portion deteriorates. The electron discharge method alloy layer 7 can be formed by electron discharge method processing as shown in the example 1 to such a part front face. The electron discharge method cell 11 attached at the nose of cam of the robot arm 16 is moved by the robot arm 16, an electron discharge method is wound so that the electron discharge method alloy layer 7 may be formed in this part front face that deteriorated, and it is ******. The electrode 1 shown in the example 1 is arranged by the electron discharge method cell 11, and it carries out an electron discharge method, using furnace water as a working liquid 3, maintaining appropriately the crevice between this electrode 1 and the processed metal 2. It reforms to the good electron discharge method alloy layer 7 of the corrosion resistance which showed the front face of the field where the structure deteriorated in the example 1 by this, or stress-corrosion-cracking-proof nature.

[0029] in addition, in an example 3 or 4, when the adhesion of the electron discharge method layer 7 and the processed metal 2 is inadequate, or when defects, such as a crack, are shown in the front face of the electron discharge method alloy layer 7 The remelting surface alloy layer 10 which irradiated the energy 9, such as a laser beam, an electron beam, or a TIG arc, remelted some of electron discharge method alloy layers 7 and processed metals 2, disappeared the defect as shown in an example 2, and was stuck with the processed metal 2 can be formed. Since this layer is a rapid solidification layer by self-cooling, it has the same good corrosion resistance as the electron discharge method alloy layer 7, and stress-corrosion-cracking-proof nature.

[0030] (Example 5) Like an example 1, the conductive ceramic electrodes 1, such as the processed metal 2, TiB2, TiN content sialon (Sialon), or SiC, are installed so that the distance between an electrode 1 and the processed metal 2 may become proper, and they carry out an electron discharge method on condition that Table 2. After a part of electrode 1 fuses by the energy of electric discharge 5, it serves as the melting alloy grain 6, mixes in the surface section of the processed metal 2 similarly fused by the energy of electric discharge 5 and stops electric discharge, the electron discharge method alloy layer 7 which becomes the surface section of the processed metal 2 from a metal component element and an electrode component element is formed.

[0031]

[Table 2]

電　極	Sialon	TiB_2
電極特性	—	—
電　流	10A	10A
パルス幅	2μs	2μs
休止幅	16μs	16μs
加工時間	10～30min	

[0032] When it is the amorphous organization where the oxide film of the above-mentioned electron discharge method alloy layer 7 is stable, the acid resistance of the surface treatment section and corrosion resistance improve remarkably, and when an alloy layer 7 also has sufficient mechanical strength collectively, stress-corrosion-cracking-proof nature also improves. Moreover, if it consists of quenching organizations which quenching organizations of a fine crystalline with a stable oxide film are consisted of, or a ceramic particle distributes even when the above-mentioned alloy layer 7 does not turn amorphously, the acid resistance of the surface treatment section and corrosion resistance improve greatly compared with non-processing material, and when an alloy layer 7 also doubles and has sufficient mechanical strength, stress-corrosion-cracking-proof nature's will improve. The SEM photograph of the cross section after the corrosion test of the electron discharge method alloy layer 7 formed of the electron discharge method using the sialon (Sialon) electrode showed that there was nothing ********** rather about corrosion damage, after forming the electron discharge method alloy layer 7 with uniform about 5-micrometer thickness in the front face of the processed metal 2 and making an aqua regia immersed for 30 minutes. Moreover, after forming the electron discharge method alloy layer 7 with the same uniform thickness as the front face of the

processed metal 2 also by the result of the SEM photograph of the cross section after the corrosion test of the electron discharge method alloy layer 7 formed of the electron discharge method using TiB2 electrode and making an aqua regia immersed for 30 minutes, it turns out that there is nothing ******** rather about corrosion damage.

[0033] (Example 6) Like what is shown in drawing 2 , when the adhesion of the electron discharge method alloy layer 7 and the processed metal 2 is inadequate, or when defects, such as a crack, are shown in the front face of the electron discharge method alloy layer 7 Irradiate the energy 9, such as a laser beam, an electron beam, or a TIG arc, to the electron discharge method alloy layer 7 which used the ceramic electrode for the front face of the processed metal 2, and was formed in it by electron discharge method processing from the processing torch 8, remelt some of electron discharge method alloy layers 7 and processed metals 2, and a defect is disappeared. The remelting surface alloy layer 10 by selfcooling which carried out rapid solidification can be formed. Since this layer 10 is a rapid solidification layer by selfcooling, it can make an abovementioned amorphous layer or an above-mentioned uniform fine crystalline layer form again.

[0034] (Example 7) The electron discharge method alloy layer 7 is formed, using a conductive ceramic electrode as an application of this invention shown in drawing 3 . It aims at improvement in the corrosion resistance in the inside of a tubular structure object like neutron flux measurement housing of a light water reactor, or stresscorrosion-cracking-proof nature. When the processed metal 2 which is a tubular structure object is welded with other structures 14, such as a pressurized container, and the pipe inside which touches corrosive environments, such as furnace water, by the thermal effect of a weld zone 15 carries out sensitization, the stress-corrosioncracking property of a member deteriorates. The electron discharge method alloy layer 7 which consists of a quenching organization which an amorphous organization as showed in the example 5, a fine crystalline, or a ceramic particle distributes by the electron discharge method can be formed to such a part front face. A perpendicular and a hand of cut are made to drive the electron discharge method cell 11, an electron discharge method is wound so that it may be formed in the part front face on which the electron discharge method alloy layer 7 deteriorated, and it is ******. Thus, it reforms to the electron discharge method alloy layer 7 which consists of the good ARUMO farce organization of the corrosion resistance which showed the front face of the field where the pipe inside deteriorated in the example 5, or stressproof **** crack nature, a fine crystalline organization, or a quenching organization that a ceramic particle distributes.

[0035] The electron discharge method alloy layer 7 which consists of a wearesistant good ARUMO farce organization, a fine crystalline organization, or a quenching organization that a ceramic particle distributes by the same processing as the above can be formed also to the front face of the structure where abrasion resistance deteriorated by the long term deterioration of a plant.

[0036] Since the operation temperature of a boilingwater-reactor plant is about 288 degrees C, organization change to the extent that corrosion resistance, stresscorrosion-cracking-proof nature, and abrasion resistance are affected in the cases, such as crystallization of the abovementioned amorphous layer or aging change of the quenching organization of a fine crystalline, is not produced. Therefore, the abovementioned property of the structure in a furnace improves greatly, and a big effect is in prevention of the long term deterioration of a light water reactor plant.

[0037] (Example 8) the method shown in an example 5 as an application of this invention shown in drawing 4 -- the example aiming at improvement in the corrosion resistance in the front face of a non-tubular structure object like the shroud of a light water reactor, a shroud support, an up grid board, and a reactor core support plate or stresscorrosion-cracking-proof nature is shown When the structure which touches corrosive environments, such as furnace water, by the thermal effect of the weld zone 15 of the processed metal 2 which is a nontubular structure object carries out sensitization, or when the stresscorrosion-cracking property of the structure deteriorates under the influence of neutron irradiation, the electron discharge method alloy layer 7 which consists of an amorphous organization and fine crystalline organization or a quenching organization which a ceramic particle distributes by the electron discharge method as shown in the example 5 can be formed to such a part front face. The electron discharge method cell 11 attached at the nose of cam of the robot arm 16 is moved by the robot arm 16, and an electron discharge method is repeated so that the electron discharge method alloy layer 7 may be formed in this part front face. Thus, it reforms to

the electron discharge method alloy layer 7 which consists of the good amorphous organization of the corrosion resistance which showed the front face of the field where the structure deteriorated in the example 5, or stresscorrosion-cracking-proof nature, a fine crystalline organization, or a quenching organization that a ceramic particle distributes.

[0038] Moreover, the electron discharge method alloy layer 7 which consists of a wearesistant good amorphous organization, a fine crystalline organization, or a quenching organization that a ceramic particle distributes by the same processing as the above can be formed also to the front face of the structure where abrasion resistance deteriorated by the long term deterioration of a plant.

[0039] In addition, in an example 7 or 8, when the adhesion of the electron discharge method alloy layer 7 and the processed metal 2 is inadequate, or when defects, such as a crack, are shown in the front face of the electron discharge method alloy layer 7, as it is shown in an example 6, you may form the remelting surface alloy layer 10.

[0040]

[Effect of the Invention] Since the extremely excellent alloy layers, such as corrosion resistance and abrasion resistance, can be given to a metallicmaterial front face according to this invention, a big effect is in the improvement in a property of material and parts of which such a property is required. Moreover, since a surface treatment is possible and the corrosion resistance of the structure in a furnace, stress-corrosion-cracking-proof nature, and abrasion resistance can be raised by alloylayer formation-ization to the structure in a light water reactor furnace, a big effect is in the avoid accident or reinforcement of a light water reactor.

[Translation done.]